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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/586,665

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Takashi Azuma

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EXAMINER

BRUTUS, JOEL F

ART UNIT

PAPER NUMBER

3768

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/586,665

Applicant(s)

AZUMA ET AL.

Examiner

JOEL F. BRUTUS

Art Unit

3768

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 January 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 6-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 6-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/C)
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____
- Paper No(s)/Mail Date: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 6-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dodd et al (US Pat: 5,833,614) in view of Wilkening (Phase-coded pulse sequence for non-Linear Imaging) and further in view of Hunt et al (6,497,665).

Regarding claims 6, 8 and 9, Dodd et al teach a system 10 includes a transmit beamformer 12 that supplies high voltage transmit waveforms in a plurality of channels via a TX/RX switch 14 to a transducer array 16. The transmit beamformer 12 and the transducer array 16 have a broadband response and are capable of transmitting the maximum allowable acoustic power densities for better signal to noise sensitivity [see fig 1 and column 3 lines 14-28]. Dodd et al teach ultrasonic energy echoed by the subject 18 at the harmonic frequency is received by the transducer array 16 and focused by the receive beamformer 22 [see fig 1 and column 3 lines 14-28]. The focused signal is preferably filtered with a high pass filter 24 and the filtered information is detected and displayed as an image by a display processor [see fig 1 and column 3 lines 14-28].

Dodd et al teach the transmit beamformer includes N channels each of which includes a delay memory 42 a delay counter 62 and a signal generator 46 [see column 3 lines 55-60]. The signal generator 70 generates pulse width modulated transmit waveforms and includes a timing sequencer 76, a waveform generator 72, a digital to analog converter (DAC) 74 [see column 4 lines 43-48]. The sequencer controls transmit/receive sequence of the transmit/receive beamformer via time control (emphasis added).

Dodd et al teach summing waveforms and signals [see column 9 lines 44-65 and column 10 lines 1-13]. Dodd et al teach referring to FIG. 3, the duration or width of each pulse 73 within the transmit waveform 71 is varied to reduce energies transmitted at harmonic frequencies, such as the second order harmonic frequencies. The duration corresponds to the beginning and end of the pulse 73. For second order harmonic imaging, the widths of the pulses 73 vary responding to an envelope which increases gradually to a maximum value and then decrease gradually within the waveform 71 [see column 7 lines 23-28].

Dodd et al don't teach controlling a carrier wave to vary in phase by $360^\circ/N$ degree/N.

However, Wilkening has proposed [as admitted by Applicant in 0007 of the specification] a method of transmitting/receiving a sound pressure pulse an N number of times using the transmitted-pulse waveform rotated in steps of $360^\circ/N$ in phase angle. For example, if $N=3$, echo signals obtained from three transmitting/receiving operations at carrier phase angles of zero degree, 120 degree, and 240 degree are

summed in this method. According to this proposal, using this method allows components up to the $(N-1)$ th-order harmonic component to be removed. It is also possible to sharply distinguish between signals of different spectral characteristics by filtering each signal during the summation, not by conducting simple summation rather the least squares method so as to maximize the difference between the tissue reflection echo signal and the contrast medium signal [see 0007, specification and page 1560 of Wilkening et al].

Therefore, one with ordinary skill in the art at the time the invention was made would have been motivated to combine Dodd et al with Wilkening et al by using adding or summing phase angles to control carrier waves as taught by Wilkening et al; for the purpose of increasing signal to noise ratio.

One skilled in the art would perform transmitting/receiving operation three times or greater because the multiple pulse approach described in this specification allows broader band transmit pulses and receive filters to be used than could be used in a conventional harmonic imaging system, resulting in greater overall imaging bandwidth and hence improved axial resolution.

Regarding claims 7 and 10-12, all other limitations are taught as set forth by the above teaching.

Dodd et al don't mention displaying a spatial indication of microbubbles.

However, Hunt et al teach electrical representation of reflected ultrasonic reflections 117 may be received at the time gain control amplifier 110, the output of the

time gain control amplifier 110 may be converted by ADC 112 into a digital representation of the various harmonic responses before being forwarded for further processing by the beamformer 114 [see column 5 lines 5-15].

Hunt et al further teach the power or mechanical index of the impinging ultrasound signal directly affects the contrast agent acoustical response. At lower powers, microbubbles resonate and emit harmonics of the transmitted frequency. The magnitude of these microbubble harmonics depends on the magnitude of the excitation signal pulse. At higher acoustical powers, microbubbles rupture and emit strong broadband signals. The display or monitor is capable of output signals from first and second sequence together (emphasis added).

Therefore, one with ordinary skill in the art at the time the invention was made would have been motivated to combine Dodd et al with Hunt et al by displaying a digital representation of various harmonic response as a spatial distribution of microbubbles; for the purpose of increasing visualization.

Response to Arguments

3. Applicant's arguments with respect to claims 6-12 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOEL F. BRUTUS whose telephone number is

(571)270-3847. The examiner can normally be reached on Mon-Fri 7:30 AM to 5:00 PM (Off alternative Fri).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Long Le can be reached on (571)272-0823. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. F. B./
Examiner, Art Unit 3768

/Long V Le/
Supervisory Patent Examiner, Art Unit 3768